CLAIMS

We claim:

1. An optical switch, comprising:

a loss element having a signal loss; and

a rare earth doped gain element optically connected in series with the loss element, the rare earth doped gain element operable to produce a signal gain;

in which the signal gain and the signal loss are about equal.

2. The optical switch of claim 1, in which the loss element comprises a waveguide including a core and a cladding, the cladding at least partially surrounding the core, in which the core is doped with at least one species of rare earth ion in the range of 5 to 75 wt%.

3. The optical switch of claim 2, in which the at least one species of rare earth ion is Er^{3+}.

4. The optical switch of claim 2, in which the at least one species of rare earth ion comprises Er^{3+} and Yb^{3+}.

5. The optical switch of claim 2, in which the cladding is doped with at least one species of rare earth ion.

6. The optical switch of claim 1, in which the loss element comprises one of a rare earth doped waveguide, an un-doped waveguide, and a neutral density filter.

7. The optical switch of claim 1, in which the rare earth doped gain element comprises a waveguide including a core and a cladding, the cladding at least partially surrounding the core, in which the core is doped with at least one species of rare earth ion in the range of 5 to 75 wt% and in which the waveguide core is connected to receive optical pump power of a wavelength that stimulates the at least one species of rare earth ion.

8. The optical switch of claim 7, in which the at least one species of rare earth ion is Er^{3+}.

9. The optical switch of claim 7, in which the at least one species of one rare earth ion comprises Er^{3+} and Yb^{3+}.

10. The optical switch of claim 7, in which the core includes silver atoms.

11. The optical switch of claim 7, in which the cladding is doped with at least one species of rare earth ion.

12. The optical switch of claim 7, in which the rare earth doped gain element is in an ON state when the optical pump power is coupled to the gain element.

13. The optical switch of claim 1, additionally comprising:

a waveguide including a core and a cladding, the cladding at least partially surrounding the core, in which the core is doped with at least one species of rare earth ion in the range of 5 to 75 wt%; and

a coupling region in optical communication with the waveguide, the coupling region connected to receive an optical pump and provide the optical pump to at least a portion of the waveguide;

in which the waveguide includes the loss element and the rare earth doped gain element.

14. The optical switch of claim 13, in which the at least one species of rare earth ion is Er^{3+}.

15. The optical switch of claim 13, in which the at least one species of rare earth ion comprises Er^{3+} and Yb^{3+}.

16. The optical switch of claim 13, in which the cladding is doped with at least one species of rare earth ion.

17. The optical switch of claim 13, in which the coupling region is located part way along the waveguide.

18. The optical switch of claim 13, in which the coupling region comprises one of a diffractive coupler, a y-branch coupler, a directional coupler, a grating coupler, a fused optical fiber coupler, and a combination thereof.

19. A method of optical switching, comprising:

optically connecting a loss element in series with a rare earth doped gain element;

passing an optical signal through the loss element and the gain element, the loss element attenuating the optical signal by a first amount; and

selectively applying an optical pump to the gain element to perform the switching, the gain element amplifying the optical signal by the first amount in response to the optical pump.

20. The method of claim 19, additionally comprising attenuating the optical signal in the gain element when the gain element is in an OFF state.